QUARTERLY AIR QUALITY TESTING
BREATHING-AIR COMPRESSORS

By David L. Spelce, MS, CIH

Ref: (a) OPNAVINST 5100.19D
(b) OPNAVINST 5100.23E, CH-1
(c) CGA G-7.1-1997

Disclaimer: This is an example of a standard operating procedure for testing compressed breathing air quality. It is adapted from the fleet maintenance requirement card, so the mention of manufacturers and specific models is for illustrative purposes only. It does not constitute an endorsement by the Navy Environmental Health Center or the Department of the Navy. Always follow specific manufacturers' directions for the equipment you are using.

For a partial list of breathing air test kits and related information, see http://www-nehc.med.navy.mil/ih/Respirator/BATestKits.htm

Paragraphs B06011 and 1506 of references (a) and (b) require testing air quality of compressors used to supply breathing air to atmosphere supplying respirators on a quarterly basis. This is to ensure that the breathing air delivered to atmosphere supplying respirators meets or exceeds Grade D quality air as defined in reference (c). Testing compressor air quality should also be performed whenever contamination of the compressed air source is suspected. If the air sample fails to meet the acceptance criteria, then the air source must not be used for breathing air until re-sampling and analysis conforms with reference (c) Grade D air. The following procedure is based on the method used by the fleet to test compressed air quality and describes using the following air quality testing apparatus:

Biosystems Four-Gas Analyzer, (Mfr part number 54-02-30102N-7) tests oxygen concentration.

Dräger Breathing Air Test Kit, Aerotest Simultan (National Dräger part number 6525960) determines the concentration of water vapor, oil, carbon monoxide (CO), and Carbon Dioxide (CO_2) contained in compressed breathing air that is delivered to atmosphere supplying respirators. The compressed air source pressure is reduced by an air test kit reducer. The following detector tubes are used to evaluate the individual components of air during air quality testing:

Air Component	Dräger Part No.
Water Vapor (H2O) 20/a-P	8103061
Oil PN* 100/A-P	8103111
Carbon Monoxide (CO) 5/A-P	6728511
Carbon Dioxide (CO_2) 100/A-P	6728521

* Internal reagent ampoule in oil detector tube contains concentrated sulfuric acid. Exercise caution when handling oil detector tubes. Do not

permit contents of detector tubes to come into contact with exposed skin. Wear protective gloves, such as 6 mil nitrile gloves and safety goggles when fracturing and handling the oil test tube.

1. Preliminary

a. Prepare the air compressor for operation according to normal operating procedures.

b. Visually inspect the breathing air source connection for contamination. Clean breathing air source connection by allowing air to momentarily blow through connection.

WARNING: Ensure all residual air pressure is relieved from equipment before loosening components or fittings.

c. Attach the air test kit adapter, reducer and measuring device to Fill Hose Assembly as shown in Figure 1. Use a wrench to connect air test kit reducer to air test kit measuring device. All other connections should be hand tightened only.

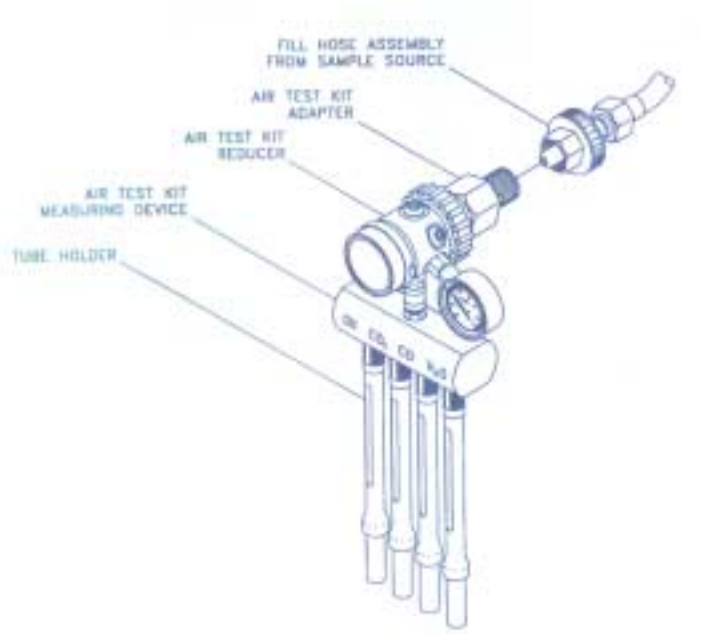

Figure 1, Air Test Kit Configuration

d. Slowly open the breathing air source and allow air to flush through the measuring device for at least 3 minutes.

e. Shut the breathing air source.

2. Analyze Charging Air Quality.

WARNING: Corrosive mist escapes from outlet end of some Dräger tubes during measurements. Avoid direct skin contact with outlet areas of tubes and tube holders during or after measurements. Rinse outlet end of each tube holder and Dräger Accuro pump thoroughly in a pail with fresh water after completion of measurements.

a. Carefully score and break off tips of Dräger tubes for oil, carbon monoxide, and carbon dioxide using tube opener. Break off both ends of each tube.

WARNING: Wear safety goggles when breaking tube ends. Handle tubes carefully - tube ends are sharp.

b. Insert tubes into tube holders of measuring device at the space marked for each appropriate tube. Flow arrow on tubes must point away from the measuring device. Refer to Figure 2.

Note: Chemicals in the water vapor tube are extremely sensitive to moisture and humidity. Tube and tube holder must be kept free from moisture during handling and use. Follow instructions carefully and do not open water vapor tube until just prior to measurement.

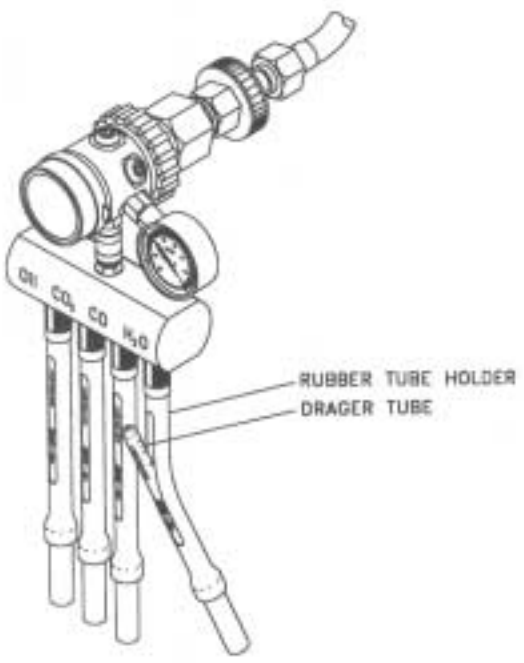

Figure 2. Air Test Kit with Dräger Tube Inserted

c. Score and break off outlet end of water vapor tube using tube opener.

d. Score inlet end of water vapor tube using tube opener; do not break off at this time.

e. Insert outlet end of water vapor tube into outlet end (lower end) of its tube holder. Position tube so that 10 minutes scale is clearly visible when fully installed in tube holder.

f. Break off inlet end tip of water vapor tube using tube opener then immediately insert tube end into tube holder.

g. Slowly open breathing air source and start electronic timer.

NOTE: Oil, carbon monoxide, and carbon dioxide tubes are calibrated for an exposure time of five minutes.

h. Remove oil, carbon monoxide and carbon dioxide tubes from tube holder after five minutes of exposure. Continue water vapor testing for 10 minutes.

i. Evaluate measurement for carbon monoxide and carbon dioxide according to the scale provided on respective Dräger tubes. Refer to the table below for acceptance test criteria.

Constituent	Allowable Measured Value per this Test Method
Carbon Monoxide (CO)	Between zero and 10 ppm
Carbon Dioxide (CO_2)	Between zero and 1000 ppm

WARNING: The internal reagent ampoule in oil test tube contains concentrated sulfuric acid. Exercise caution when handling the oil test tube. Do not permit contents of tube to come into contact with exposed skin. Wear protective gloves, such as 6 mil nitrile gloves and safety goggles when fracturing and handling the oil test tube.

j. Bend the oil test tube sharply at the indicated position (between double dots), so that the outer glass tube and internal reagent ampoule break. Allow ampoule fluid to flow into the indicating layer of the tube. Use the Dräger Accuro pump to apply light suction to outlet of tube until approximately 10 mm (3/8 inch) of indicating layer is covered with ampoule fluid.

k. Wait 1 minute before interpreting results. If no color change occurs, concentration of oil in air sample is less than 5 mg/m^3 and is acceptable.

l. Remove the water tube from tube holder after 10 minutes on the timer and read measurement. A color change to reddish-brown is an indication of moisture.

NOTE: A reddish-brown color is an indication of water and is used to determine the level of moisture within the air sample. There are several color changes

during this chemical reaction before turning reddish-brown. Read only the reddish-brown level.

Read level of moisture on 10 minute scale of the tube. Acceptance criteria for water vapor is less than or equal to 18 mg/m^3.

m. To measure oxygen, insert the straight barbed fitting of Dräger breathing air test kit into CO tube holder as shown in Figure 3.

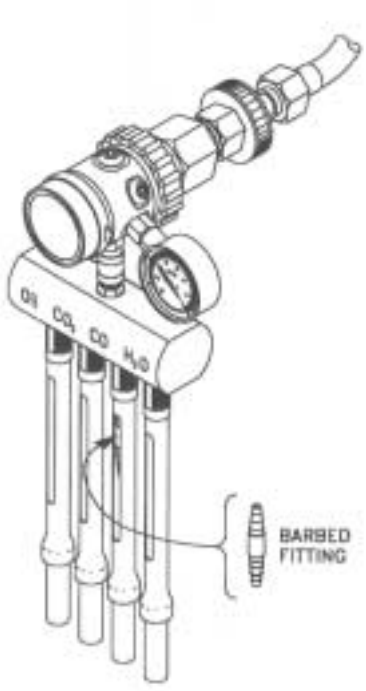

Figure 3, O_2 Measuring Connection

n. Ensure the breathing air source is open and sample air is flowing from measuring device.

o. Remove slip-on adapter from four-gas analyzer. Connect a short length of sampling tube between barbed fitting and slip-on adapter as shown in Figure 4.

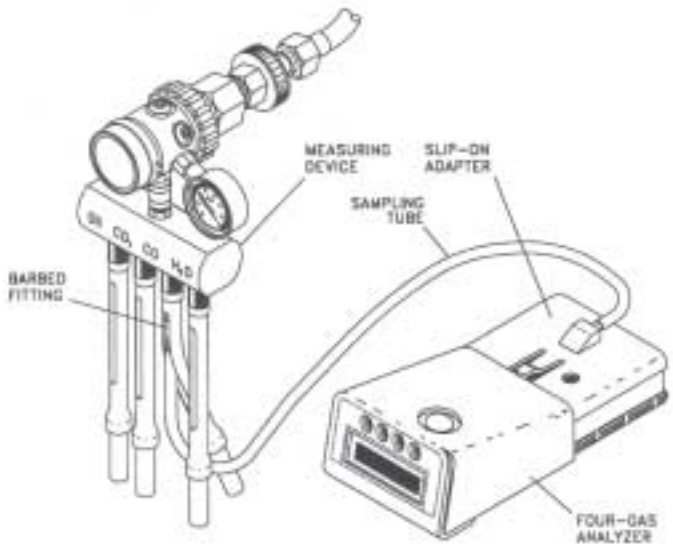

Figure 4, Four-Gas Analyzer Connection to Air Test Kit

p. Measure air sample for oxygen content as follows:

(1) Turn analyzer on; after automatic start up routine of analyzer, read gas reading percentage displayed on screen.

(2) Locate analyzer in an area of fresh air. Wait three minutes for gas readings to stabilize.

(3) Press mode button three times within two seconds; Zero Calibration Mode screen should display. Within five seconds press mode button one time. Screen should display "Zero Calibration Please Wait," followed by "Zero Calibration Completed."

(4) Wait five seconds; display should return to gas readings in percent.

(5) Attach slip-on adapter to analyzer; and start electronic timer.

(6) After one minute, read oxygen content from analyzer screen display. Reading should be greater than or equal to 19.5% and less than or equal to 23.5%.

NOTE: If measurement for water vapor, oil, carbon monoxide, carbon dioxide or oxygen indicate an unsatisfactory result, any or all individual tests may be repeated.

q. Secure breathing air source according to normal operating procedures and disconnect the Four-Gas Analyzer and breathing air test kit from the air source.

r. Rinse the outlet end of each tube holder with clean fresh water. Cycle hand pump several times with discharge aimed into pail of water and dispose of water immediately.

s. Thoroughly dry all air test kit components prior to stowage.

t. Record test results on a Breathing Air Quality Report similar to the one shown below and maintain copies in a three ring binder. Recording test results in a Microsoft Excel® Breathing Air Compressor Spreadsheet similar to the one shown below is highly recommended.

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COMPRESSOR
BREATHING AIR QUALITY REPORT

Compressor Model:_____ Date:_____

Serial No:_____

COMPONENT ANALYZED	SPECIFICATION FOR GAS	RESULTS
Oxygen	19.5 - 23.05 %	%
Carbon Dioxide	1000 PPM Max	ppm
Carbon Monoxide	10 ppm Max	ppm
Oil	5 mg/m^3	mg/m^3
Water Vapor	18 mg/m^3 (24 ppm v/v) Or moisture content corresponding to the dew point at 1 atm. that is at least 10^o F lower than the temperature in which the respirator will be worn (see note 3 to Table 1 and Table 3 of CGA G-7.1-1997) or (***NEEDS WEB ADDRESS for file "Dew Point Calculator.mdb")***	mg/m^3 or ppm
Odor	Not Objectionable	

This is to certify that the above referenced sample DOES/DOES NOT meet the Grade D air purity standards for compressed breathing air per CGA G-7.1-1997.

Sample Taken By:_____

Next Sample Due on_____

BREATHING AIR COMPRESSOR LOG

Date	Compressor Run Time	Maintenance Performed	Name of Operator